PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-092125

(43)Date of publication of application : 28.03.2003

(51)Int.Cl. H01M 8/04
H01M 8/06
// H01M 8/10

(21)Application number : 2002-084445

(22)Date of filing : 25.03.2002

(71)Applicant : HONDA MOTOR CO LTD

(72)Inventor : UEDA KENICHIRO
MURAKAMI GIICHI
HAYASHI MASANORI
AOYANAGI AKIRA

(30)Priority

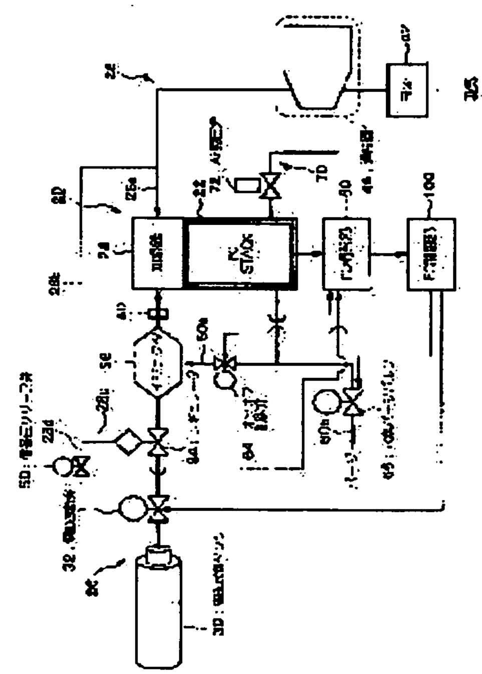
Priority number : 2001209832 Priority date : 10.07.2001 Priority country : JP

(54) FUEL CELL CONTROL DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell control device capable of detecting the failure of a hydrogen purge valve independent of causes, mechanical or electrical.

SOLUTION: This fuel cell control device comprises a transient state determining means determining whether the power output variation of a fuel cell stack 22 is in the specified range or not; a hydrogen purge command detecting part detecting the presence or no presence of a purge command of the hydrogen purge valve 66; a failure determining part comparing a target pressure value with an actual value for determining opening failure and closing failure of the hydrogen purging valve; and an alarm generating means generating an alarm signal corresponding to the determination result in the failure determination part.



LEGAL STATUS

[Date of request for examination] 04.01.2005

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] A fuel cell and a fuel-supply means to have an exhaust air fuel circulation means to carry out recycling of the exhaust air hydrogen which supplies hydrogen to this fuel cell from a hydrogen bomb, and is discharged from the fuel exhaust air section of this fuel cell to the fuel air-supply section of this fuel cell, An oxidizer supply means to supply an oxidizer to this fuel cell, and the reactant gas amount-of-supply adjustment device which adjusts the oxidizer amount of supply from this oxidizer supply means to this fuel cell, and the fuel amount of supply from said fuel-supply means to this fuel cell, A demand output current decision means to determine the demand output current of this fuel cell according to the demand of this load in case this fuel cell is connected with a load and power is supplied to this load, The reactant gas amount-of-supply control means which controls the reactant gas amount of supply to said fuel cell by said reactant gas amount-of-supply accommodation means so that said demand output current is acquired, A hydrogen discharge means to discharge exhaust air hydrogen to the exterior of a fuel cell on the fuel exhaust air circulating flow way which connects a fuel circulation means with said fuel exhaust air section, A fuel cell judging means to detect the output state of said fuel cell and to output a hydrogen discharge command to said hydrogen discharge means according to said condition of having detected, A transient judging means to judge whether it is a preparation ********** control unit and the range of fluctuation of the generated output of said fuel cell within convention time amount is convention within the limits, A hydrogen discharge command detection means to detect the existence of the hydrogen discharge command to a hydrogen discharge means, The fault detection means of a hydrogen discharge means to judge failure of said hydrogen discharge means based on the target preassure force and detection value of said fuel air-supply section, The fuel cell control unit characterized by establishing an alarm generating means to generate the alarm of open failure or closed failure either when the fault detection means concerned detects failure of said hydrogen discharge means.
[Claim 2] The fuel cell control unit according to claim 1 characterized by establishing a load limitation means to restrict the upper limit of the demand generation-of-electrical-energy output to a fuel cell to below default value according to the closed failure alarm of said alarm generating means.
[Claim 3] The fuel cell control unit according to claim 1 characterized by to establish the fuel exhaust air circulating flow way closedown means which closes said fuel exhaust air circulating flow way between a fuel exhaust air circulation means and said hydrogen discharge means according to the open failure alarm of said alarm generating means while establishing a load-limitation means restrict the upper limit of the output request to a fuel cell to below default value according to the open failure alarm of said alarm generating means.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell control device applied to fuel cell powered vehicles, and relates to the fuel cell control device which detects failure of the hydrogen purge valve especially prepared in the hydrogen outflow way of a fuel cell.
[0002]
[Description of the Prior Art] Electromotive force can be acquired by supplying a fuel (hydrogen) to the anode of the fuel cell stack which carried out the laminating of the PEM mold fuel cell cel to two or more serials, and supplying an oxidizer (air) to a cathode. If power and water are generated by the reaction of hydrogen and oxygen, this generation water serves as waterdrop and said fuel cell piles up in the reactant gas passage of a fuel cell cel, it will take up reactant gas passage and will cause the fall of cel output voltage. In order to call this phenomenon flooding and to prevent or cancel this, a fuel cell discharges generation water outside, fixed electric energy or when [fixed] a cel electrical potential difference falls below to a regular electrical potential difference when carrying out the time amount generation of electrical energy or. Moreover, if generation water waterdrop-izes and takes up reactant gas passage, since reactant gas will no longer be supplied after a puddle, lack of gasoline occurs partially, a damage is given to the solid-state polyelectrolyte film, and degradation is produced. In order to discharge the above-mentioned generation water, the hydrogen purge valve is prepared in the anode gas exhaust air passage of the fuel cell system of a pressurization hydrogen cycloid type, and said generation water is discharged outside from a fuel cell by opening this hydrogen purge valve.
[0003]
[Problem(s) to be Solved by the Invention] As described above, the hydrogen purge valve is bearing the very important role, when a fuel cell system maintains a function. Then, this invention offers the fuel cell control unit which can detect failure of a hydrogen purge valve. Moreover, this invention offers the fuel cell control unit which can operate a fuel cell system smoothly, when a hydrogen purge valve is closed failure or open failure.
[0004]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention indicated to claim 1 To a fuel cell (for example, fuel cell stack 22 in an operation gestalt), and this fuel cell, a hydrogen bomb Hydrogen is supplied from (for example, the high-pressure hydrogen tank 30 in an operation gestalt). An exhaust air fuel circulation means to carry out recycling of the exhaust air hydrogen discharged from the fuel exhaust air section of this fuel cell to the fuel air-supply section of this fuel cell A fuel-supply means to have (for example, the ejector 36 in an operation gestalt) (for example, regulator 34 in an operation gestalt), An oxidizer supply means to supply an oxidizer to this fuel cell (for example, supercharger 44 in an operation gestalt), The reactant gas amount-of-supply adjustment device which adjusts the oxidizer amount of supply from this oxidizer supply means to this fuel cell, and the fuel amount of supply from said fuel-supply means to this fuel cell (for example, demand/supply capability calculation section 94 in an operation gestalt), A demand output current decision means to determine the demand output current of this fuel cell according to the demand of this load in case this fuel cell is connected with a load and power is supplied to this load (for example, energy management section 8 in an operation gestalt), The reactant gas amount-of-supply control means which controls the reactant gas amount of supply to said fuel cell by said reactant gas amount-of-supply adjustment device so that said demand output current is acquired (for example, regulator 34 in an operation gestalt), A hydrogen discharge means to discharge exhaust air hydrogen to the exterior of a fuel cell on the fuel exhaust air circulating flow way which connects a fuel

circulation means with said fuel exhaust air section (for example, hydrogen outflow way 60b in an operation gestalt, the hydrogen purge valve 66), A fuel cell judging means to detect the output state of said fuel cell and to output a hydrogen discharge command to said hydrogen discharge means according to said condition of having detected (for example, fuel cell control section 100 in an operation gestalt), It is a preparation ********** control unit. The range of fluctuation of the generated output of said fuel cell within convention time amount A transient judging means to judge whether it is convention within the limits (for example, processings S04, S08, and S12, in the hydrogen purge valve fault detection section 90 in an operation gestalt), A hydrogen discharge command detection means to detect the existence of the hydrogen discharge command to a hydrogen discharge means (for example, processing S16, in the hydrogen purge valve fault detection section 90 in an operation gestalt), The fault detection means of a hydrogen discharge means to judge failure of said hydrogen discharge means based on the target preassure force and detection value of said fuel air-supply section (for example, processings S20 and S26, in the hydrogen purge valve fault detection section 90 in an operation gestalt), When the fault detection means concerned detects failure of said hydrogen means, it is characterized by establishing an alarm generating means (for example, hydrogen purge valve fault detection section 90 in an operation gestalt) to generate the alarm of open failure or closed failure either. Thus, with constituting, when a hydrogen discharge means is closed failure (failure which does not open), or open failure (failure which is not closed), it can detect certainly. Moreover, since the failure judging of a hydrogen discharge means is not performed when it judges with a transient in said transient judging means, the dependability of a failure judging can be raised. In addition, a timer style is prepared, and when the condition of having been judged with closed failure or open failure carries out fixed time amount continuation, you may make it judge failure of a hydrogen discharge means for said fault detection means. Moreover, change (the amount of treading in of an accelerator pedal) of the amount required of the demand power generating section can be included in the decision criterion of the transient judged with said transient judging means.

[0005] Invention indicated to claim 2 is characterized by establishing a load limitation means (for example, limiter 92 in an operation gestalt) to restrict the upper limit of the output request to a fuel cell to below default value according to the closed failure alarm of said alarm generating means. Thus, with constituting, even when a hydrogen discharge means is closed failure, the generation-of-electrical-energy capacity of a fuel cell is made to hold in the fixed range, and operation can be performed continuously. At this time, by operating in the low-power output region where the utilization factor of hydrogen is low, the amount of supply of hydrogen can be stopped and the amount of generation water can be stopped.

[0006] While invention according to claim 3 establishes a load limitation means to restrict the upper limit of the output request to a fuel cell to below default value according to the open failure alarm of said alarm generating means It responds to the open failure alarm of said alarm generating means. Said fuel exhaust air circulating flow way between said fuel exhaust air circulation means and said hydrogen discharge means It is characterized by establishing the fuel exhaust air circulating flow way closedown means (for example, on-off control valve 64 in an operation gestalt) which closes (for example, hydrogen circulating flow way 60a in an operation gestalt). Thus, since it is lost that said fuel exhaust air circulating flow way turns into a bypass way in parallel with a fuel cell, and the hydrogen of a hydrogen feeder current way is discharged from this bypass way with constituting when a hydrogen discharge means is open failure, useless discharge of hydrogen can be prevented.

[0007]

[Embodiment of the Invention] Hereafter, the fuel cell control unit in the operation gestalt of this invention is explained with a drawing. Drawing 1 is the outline block diagram showing the control unit of the fuel cell system 20 in the operation gestalt of this invention. The fuel cell stack (fuel cell) 22 has the structure where carried out two or more laminatings of the fuel cell cel which comes to pinch a solid-state poly membrane with an anode side diffusion electrode and a cathode side diffusion electrode, and it was made to unify. The humidifier 24 which the hydrogen feeder current way 26 and the air (oxygen) feeder current way 28 connected is formed in said fuel cell stack 22, and each gas (hydrogen, air) is supplied to said fuel cell stack 22 through the humidifier 24 concerned.

[0008] First, the hydrogen feeder current way 26 is explained. The high-pressure hydrogen tank 30 which is a hydrogen source of supply is formed in the hydrogen feeder current way 26, and it enables it to supply high-pressure hydrogen to the hydrogen feeder current way 26. Moreover, the electric latching valve 32 is formed in the hydrogen feeder current way 26 by the side of said high-pressure hydrogen tank 30, and the switching action of the electric latching valve 32 concerned is made to perform supply interruption control of hydrogen. The regulator 34 is formed in the downstream of said electric latching valve 32. It has

connected with air feeder current way 28c which mentions a detail later, and said regulator 34 enables it to adjust the hydrogen pressure force of the hydrogen feeder current way 26 according to the pressure of air. The ejector 36 is formed in the downstream of said regulator 34. Said ejector 36 is connected to hydrogen circulating flow way 60a which mentions a detail later. Said ejector 36 absorbs the hydrogen of said hydrogen circulating flow way 60a with negative pressure, and he is trying to send out this absorbed hydrogen to the hydrogen feeder current way 26 of said ejector 36 downstream. The hydrogen feeder current way 26 is connected to said humidifier 24 by said ejector 36 downstream, and after the hydrogen in said hydrogen feeder current way 26 is humidified by moderate humidity with this humidifier 24, it is supplied to the anode side of the fuel cell stack 22. And the pressure sensor 40 is formed in the ejector 36 downstream, and it enables it to measure the hydrogen pressure force of said hydrogen feeder current way 26 with the pressure sensor 40 concerned in this operation gestalt.

[0009] Next, the air (oxygen) feeder current way 28 is explained. The filter 42 is formed in the upstream and the air feeder current way 28 is made to remove the dust of air with the filter 42 concerned. The supercharger 44 is formed in the downstream of said filter 42, and it enables it for the supercharger 44 concerned to adjust the supply pressure of air. The air feeder current way 28 has branched on the air feeder current ways 28a and 28b. One air feeder current way 28a is connected to said humidifier 24, and after the air in said air feeder current way 28a is humidified by moderate humidity with this humidifier 24, it is supplied to the cathode side of the fuel cell stack 22. Air feeder current way 28b of another side branched on the air feeder current ways 28c and 28d further, the signal pressure relief valve 50 is formed in 28d of said air feeder current ways, and said air feeder current way 28c has measured the air pressure force in 28d of air feeder current ways by said signal pressure relief valve 50 while connecting with said regulator 34. By making into signal pressure the pressure of the air supplied to a regulator 34, the hydrogen pressure force can be adjusted so that the pressure of the hydrogen which passed said regulator 34 may turn into a pressure of the predetermined range according to said air pressure force. For this reason, the electrode differential pressure in the fuel cell stack 22 can be adjusted to the proper range.

[0010] If hydrogen is supplied to the reaction side of the anode side diffusion electrode of the fuel cell stack 22, hydrogen will be ionized here and it will move to a cathode electrode side through the solid-state polyelectrolyte film. The electron produced in the meantime is taken out by the external circuit, and is used as electrical energy of a direct current. Since oxygen is supplied to the cathode electrode, a hydrogen ion, an electron, and oxygen react and water is generated. The hydrogen and oxygen after a generation of electrical energy are discharged by the fuel cell stack 22 exterior from the hydrogen outflow way 60 and the air outflow way 70, respectively. These are explained below.

[0011] The hydrogen outflow way 60 is explained. The hydrogen outflow way 60 has branched to hydrogen circulating flow way 60a and hydrogen outflow way 60b. It has connected with said ejector 36 and hydrogen circulating flow way 60a enables it to supply the hydrogen in the hydrogen passage 60a concerned to said ejector 36. For this reason, the fuel cell stack 22 is made to circulate through the hydrogen discharged by the hydrogen outflow way 60 while it had been unreacted again, and it is supplied to it. He has formed the on-off control valve 64 in said hydrogen circulating flow way 60a, and is trying for the on-off control valve 64 concerned to make hydrogen circulating flow way 60a open and close with an electrical signal.

[0012] The hydrogen purge valve 66 is formed and hydrogen outflow way 60b of another side enables it to perform hydrogen purge and adjustment of electrode differential pressure by opening the hydrogen purge valve 66 concerned. In addition, it is made to generate electricity by circulating hydrogen at the time of a usual generation of electrical energy of the fuel cell system 20, without opening the on-off control valve 64 and discharging hydrogen outside, while closing said purge valve 66. The air outflow way 70 is explained. The air pressure regulating valve 72 is formed in the air outflow way 70, and pressure regulation can be made to perform by opened and closing the air pressure regulating valve 72. The fuel cell information bureau (FC information bureau) 80 connects with the fuel cell stack 22 electrically, and a current value, an electrical-potential-difference value, and the current value and electrical-potential-difference value in the fuel cell stack 22 whole for every fuel cell cel are inputted into it here. [in the fuel cell stack 22] Furthermore, said fuel cell information bureau 80 connects with said electric latching valve 32 and the signal pressure relief valve 50 electrically, and the temperature of the hydrogen pressure force, the air pressure force, and the fuel cell stack 80 etc. is inputted.

[0013] And in this operation gestalt, the fuel cell control section (FC control section) 100 is formed. As shown in drawing 3 , the hydrogen purge valve fault detection section 90 linked to said fuel cell information bureau 80 is formed, and a failure judgment of the hydrogen purge valve 66 is made on said fuel cell control section 100 in this hydrogen purge valve fault detection section 90. Said hydrogen purge valve fault-

detection section 90 has the failure judging section which judges open failure and closed failure of the hydrogen purge valve 66 based on a transient judging means to judge whether generation-of-electrical-energy output fluctuation of the fuel cell stack 22 is convention within the limits, and the target preassure force value and detection value of an anode, and an alarm generating means generate an alarm when open failure or closed failure is judged in the failure judging section concerned.

[0014] Drawing 2 is the processing flow of the hydrogen purge valve failure detection in the operation gestalt of this invention. First, the moving average IFCDLY of the IFC (fuel cell generation-of-electrical-energy current) value detected in said FC information bureau 80 is computed (S02). In this operation gestalt, said IFCDLY is the moving average in 100msec(s) of IFC, and is computing each IFCDLY every 10ms. And the difference of the moving average IFCDLY of the newest IFC value and the moving average IFCDLYN1 in front of that is taken, and it judges whether it is smaller than set point #IFCDLYNST in this difference (S04). When said difference is larger than the set point (at the time of NO), since it is a rapid transient, a judgment about failure detection of the hydrogen purge valve 66 is not made, but the fail decision time amount (tmBVH2OCLS) used as the criteria of closed failure decision and the fail decision time amount (tmBVH2OOPN) used as the criteria of open failure decision are set up, respectively (S06), and the flow of failure detection processing is once ended. Although rapid treading in of an accelerator etc. can be considered to the cause of such a rapid transient, in such a case, the dependability of a failure judging can be raised by not performing failure detection of the hydrogen purge valve 66. The fail decision time amount set up at this step serves as timer initial value. Moreover, this flow serves as a subtractor circuit, and when once ending a flow and redoing again, constant value is subtracted from the set-up timer values (for example, the above-mentioned fail decision time amount etc.). About this, a detail is mentioned later.

[0015] In S06, when said difference is smaller than the set point (at the time of YES), it judges whether air purging is performed or the signal pressure relief valve 50 is open (S08). In S08, if it is a time (at the time of YES) of judging it as the inside of air purging, after setting up the timer value (tmBVAREOPN) of air purging, the above-mentioned S06 will be processed and the flow of failure detection processing will once be ended. Since the hydrogen pressure force is adjusted by said regulator 34 based on the air pressure force as described above, also in a hydrogen side, a pressure declines in connection with the pressure drop by the side of the air by air purging. For this reason, if it is among air purging, the dependability of failure detection is raised more, without performing failure detection of the hydrogen purge valve 66.

[0016] In S08, when it judges that it is not among air purging (at the time of NO), ******** [immediately after air-purging termination] is judged further (S12). This decision is judged by whether the above-mentioned timer value (tmBVAREOPN) is larger than 0. In S12, when it is judged as immediately after air-purging termination (at the time of YES), after not performing failure detection of the hydrogen purge valve 66 but processing the above-mentioned S06, the flow of failure detection processing is once ended. In S12, when it judges that it is not immediately after air-purging termination (at the time of NO), failure judging processing of the hydrogen purge valve 66 is performed. Thus, it can write and the dependability of failure detection can be raised further further. In addition, although the case where air purging was performed by the signal pressure relief valve 50 in this operation gestalt was explained, the processing of S08-S12 described above when there was no signal pressure relief valve 50, or when air purging was not performed is omissible.

[0017] Failure judging processing of the hydrogen purge valve 66 is explained. First, based on the above-mentioned IFCDLY, the assumption hydrogen pressure force (PH2TARGET) is computed (S14). In this operation gestalt, the related property of IFCDLY and the assumption hydrogen pressure force is held as table data, and the assumption hydrogen pressure force corresponding to said IFCDLY is computed from said table data. And the existence of a hydrogen purge command is judged (S16), when the hydrogen purge command has come out, closed failure is judged (when it is YES), and open failure is judged when the hydrogen purge command has not come out (when it is NO). In addition, in an operation gestalt, although the case where a related property was held by table data was explained, the assumption hydrogen pressure force may be computed not only from this but from operation expression.

[0018] The case where there is a hydrogen purge command is explained. First, the value of the fail decision time amount (tmBVH2OCLS) of closed failure judges whether it is 0 (S18). In S18, when the above-mentioned fail decision time amount is not 0 (at the time of NO), it judges that it is closed failure. In this operation gestalt, the difference of said assumption hydrogen pressure force and the actual hydrogen pressure force (PH2STKIN) measured with the pressure sensor 40 is taken, and it judges whether this difference is larger than the set point (#PDH2BVH2OCLS) (S20). When the hydrogen purge valve 66 is open with a hydrogen purge command, the actual pressure should fall from the set point rather than the

assumption pressure. Therefore, it is judged that the hydrogen purge valve 66 is normal in S20 when differential pressure is larger than the set point (at the time of YES), and after processing the above-mentioned S06, the flow of failure detection processing is once ended. And since there is no differential pressure with ****** in S20 when differential pressure is smaller than the set point (at the time of NO), the hydrogen purge valve 66 is judged to be closed failure, and ends the flow of failure detection processing. Constant value is subtracted from the value of the fail decision time amount over the closed failure described above at the time of this flow termination. Therefore, when the above-mentioned processing is repeated and the value of fail decision time amount is set to 0, it is judged that the condition of fixed time amount close failure continued in S18, and the judgment (Close Fail) of closed failure of the hydrogen purge valve 66 is decided (S22).

[0019] The case where there is no hydrogen purge command is explained. First, the value of the fail decision time amount (tmBVH2OOPN) of open failure judges whether it is 0 (S24). In S24, when the above-mentioned fail decision time amount is not 0 (at the time of NO), it judges that it is open failure. In this operation gestalt, the difference of said assumption hydrogen pressure force and the actual hydrogen pressure force (PH2STKIN) measured with the pressure sensor 40 is taken, and it judges whether this difference is smaller than the set point (#PDH2BVH2OOPN) (S26). Since there is no hydrogen purge command, the hydrogen purge valve 66 should have closed and the actual pressure should serve as the almost same value as an assumption pressure. Therefore, it is judged that the hydrogen purge valve 66 is normal in S26 when differential pressure is smaller than the set point (at the time of YES), and after processing the above-mentioned S06, the flow of failure detection processing is once ended. And since differential pressure is too large in S26 when differential pressure is larger than the set point (at the time of NO), the hydrogen purge valve 66 is judged to be open failure, and ends the flow of failure detection processing. At this time, constant value is subtracted from the value of the fail decision time amount over the above-mentioned open failure. Therefore, when the above-mentioned processing is repeated and the value of fail decision time amount is set to 0, it is judged that the condition of fixed time amount open failure continued in S18, and the judgment of open failure of the hydrogen purge valve 66 is decided (S28). Thus, if a hydrogen purge valve is the electric cause and it will be the mechanical cause closed failure or when open failure of is done, since there is no change in the abnormalities in a pressure occurring, closed failure or open failure of the hydrogen purge valve 66 is detectable with constituting, regardless of a cause.

[0020] Hereafter, the control at the time of detecting open failure or closed failure of the hydrogen purge valve 66 is explained. Said fuel cell information bureau 80 has connected with the fuel cell control section 100, and the fuel cell control section 100 concerned enables it to control the fuel cell system 20 based on the information from the fuel cell information bureau 80. It has connected with the electric latching valve 32, the hydrogen purge valve 66, and the on-off control valve 64 electrically, and said fuel cell control section 100 enables it to perform closing motion control of each valve 32, 66, and 64, as shown in drawing 1 .

[0021] First, when closed failure is detected, the output upper limit in the fuel cell stack 22 is set up through the command from said fuel cell control section 100. About this, a detail is mentioned later. Moreover, it operates in the low-power output region which can maintain SUTOIKI of hydrogen highly by making into the minimum the hydrogen supplied from the high-pressure hydrogen tank 30 by adjusting the opening of the electric latching valve 32 by the fuel cell control section 100. Here, SUTOIKI of hydrogen means the ratio (QH0/QH1) of the amount of hydrogen (QH0) supplied to the fuel cell stack to the amount of hydrogen (QH1) consumed by the fuel cell stack. If SUTOIKI is proportional to the amount of supply hydrogen and SUTOIKI falls, the supply flow rate of hydrogen gas will fall and a generation-of-electrical-energy current will fall at the time of the consumed amount regularity of hydrogen (generation-of-electrical-energy current regularity) according to the fall of the supply flow rate of hydrogen gas. For this reason, as described above, the supply flow rate of hydrogen gas can be stopped by making SUTOIKI high, and the generation water which collects in a fuel cell stack can be pressed down to the minimum. Furthermore, by raising SUTOIKI of air, the reverse osmosis from the cathode side of generation water to an anode side can be reduced, and the increment in the generation water which piles up in an anode electrode side can be prevented.

[0022] Next, the case where open failure is detected is explained. While restricting by the limiter 92 like the case of the above-mentioned closed failure, at this time, the on-off control valve 64 is set up off with the electrical signal from said fuel cell control section 100, and circulation of said hydrogen circulating flow way 60a is intercepted at it. Thereby, hydrogen flows backwards the suction section of an ejector 36, it can prevent that it is discharged outside and it is supplied from the hydrogen purge valve 66 through hydrogen circulating flow way 60a, and the hydrogen from the hydrogen feeder current way 26 can supply the fuel cell stack 22 certainly. Moreover, it can suppress emitting the hydrogen supplied vainly with restricting the

upper limit output in the fuel cell stack 22 to the minimum.

[0023] Drawing 3 is the block diagram showing the important section of a fuel cell powered vehicle 1 in which the fuel cell control unit in the operation gestalt of this invention was carried. In said fuel cell powered vehicle 1, the fuel cell stack 22 and a capacitor 3 are formed in juxtaposition to auxiliary machinery 4 and the inverter 5 linked to a motor 6, and power is supplied from the fuel cell stack 22 or a capacitor 3. Moreover, the reactant gas feeders (reactant gas feeder current way) 26 and 28 are connected to said fuel cell stack 22, and reactant gas (hydrogen, air) is supplied to the fuel cell stack 22.

[0024] Said inverter 5 is connected to the motor control section 7. The motor control section 7 computes power required for the drive of said motor 6 by computing demand electric energy from input data. There are the amount of treading in of an accelerator pedal (Ap), a rotational frequency (Nm) of a motor 6, a current (Im), and an electrical potential difference (Vm) in said data. It connects with the energy management section 8, and said motor control section 7 transmits said demand electric energy to the energy management section 8 concerned. The energy management section 8 computes the amount of target generations of electrical energy in the fuel cell stack 22 while computing the amount from a capacitor 3 which can be discharged. It has connected with the fuel cell control section 100, and said energy management section 8 can transmit now generation-of-electrical-energy indicated value to the fuel cell control section 100. Said generation-of-electrical-energy indicated value is inputted into demand/supply capability calculation section 94 of said fuel cell control section 100 when not detecting failure by the hydrogen purge valve 66 (refer to drawing 1). Said demand/supply capability calculation section 94 makes it generate electricity by supplying a signal to the reactant gas feeders 26 and 28, and supplying reactant gas to delivery and the fuel cell stack 22. It connects with the fuel cell information bureau 80, and the fuel cell stack 22 inputs required data into output-value calculation in the fuel cell information bureau 80 concerned. Said fuel cell information bureau 80 connects with said demand/supply capability calculation section 94, and transmits said data. And demand/supply capability operation part 94 transmits the output threshold value of the fuel cell stack 22 to the energy management section 8. The energy management section 8 transmits the above-mentioned threshold value to the motor control section 7, and enables it to restrict an output value.

[0025] In the fuel cell control section 100, it has the hydrogen purge valve fault detection section 90, a limiter 92, and the input switch section 93, and said hydrogen purge valve fault detection section 90 is connected to the fuel cell information bureau 80. For the information from said fuel cell information bureau 80, when failure is detected in said hydrogen purge valve fault detection section 90, the generation-of-electrical-energy indicated value from the energy management section 8 is inputted into a limiter 92 by the input switch section 93. Thus, it writes, and since a limit can be applied by the limiter 92 even if it is the case where it is the value to which generation-of-electrical-energy indicated value exceeds a limit of the fuel cell stack 22, whenever [insurance] can be secured and operation of the fuel cell system 20 can be continued.

[0026]

[Effect of the Invention] Since there is no change in the abnormalities in a pressure occurring when according to invention indicated to claim 1 open failure of is done and a hydrogen discharge means will be [closed failure or] the mechanical cause if it is the electric cause as explained above, closed failure or open failure of a hydrogen discharge means is detectable regardless of a cause. Moreover, since the failure judging of a hydrogen discharge means is not performed when it judges with a transient in said transient judging means, incorrect recognition of a failure judging can be eliminated.

[0027] Moreover, even when a hydrogen discharge means is closed failure, the yield of the generation water at the time of a generation of electrical energy can be made into the minimum, and the generation-of-electrical-energy capacity of a fuel cell can be made to hold in the fixed range according to invention indicated to claim 2.

[0028] Moreover, since according to invention indicated to claim 3 it is lost that it is discharged via a fuel exhaust air circulating flow way before the hydrogen supplied from a fuel-supply means is supplied to a fuel cell even when a hydrogen discharge means is open failure, useless discharge of hydrogen can be prevented.

[Translation done.]

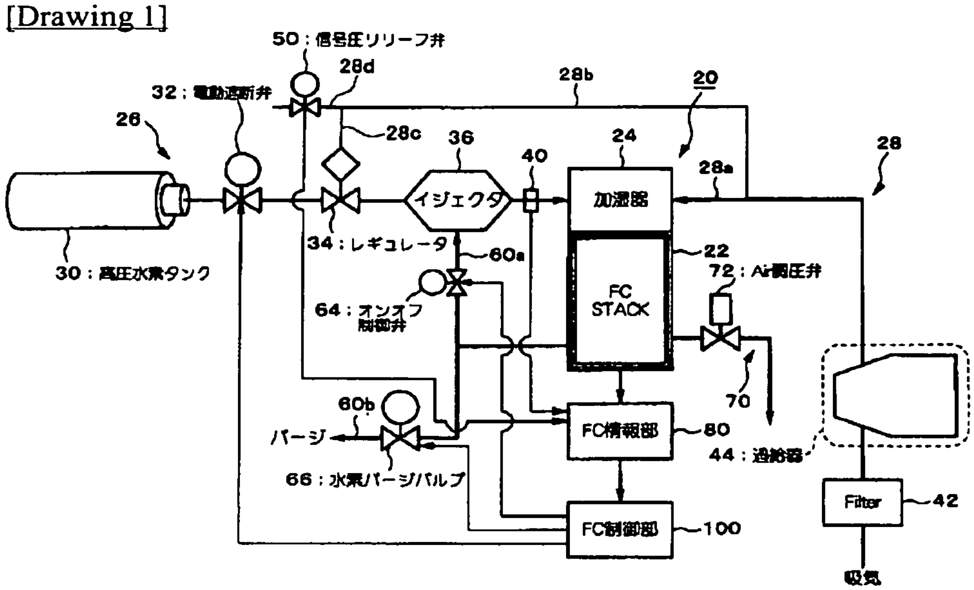
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

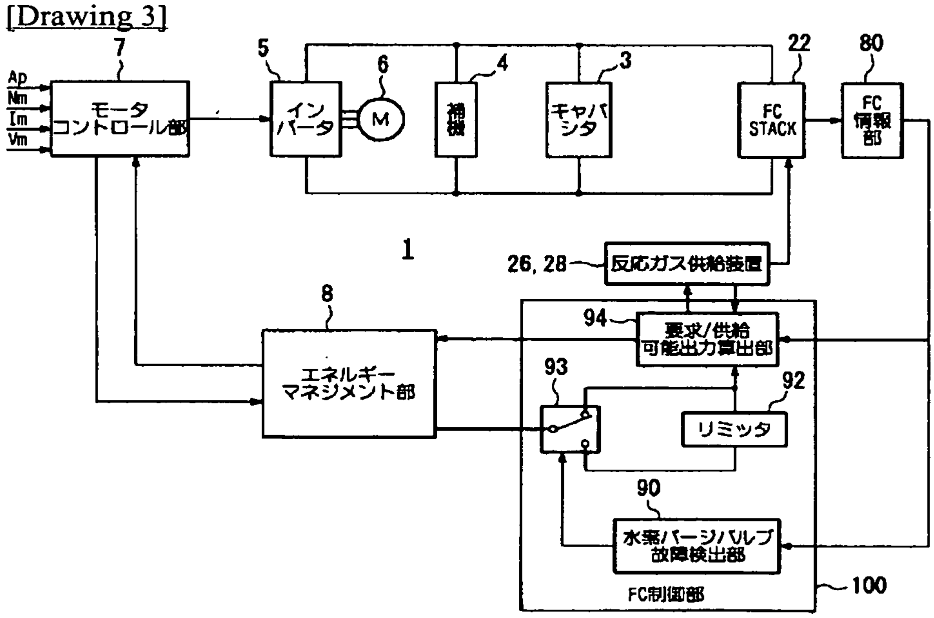
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

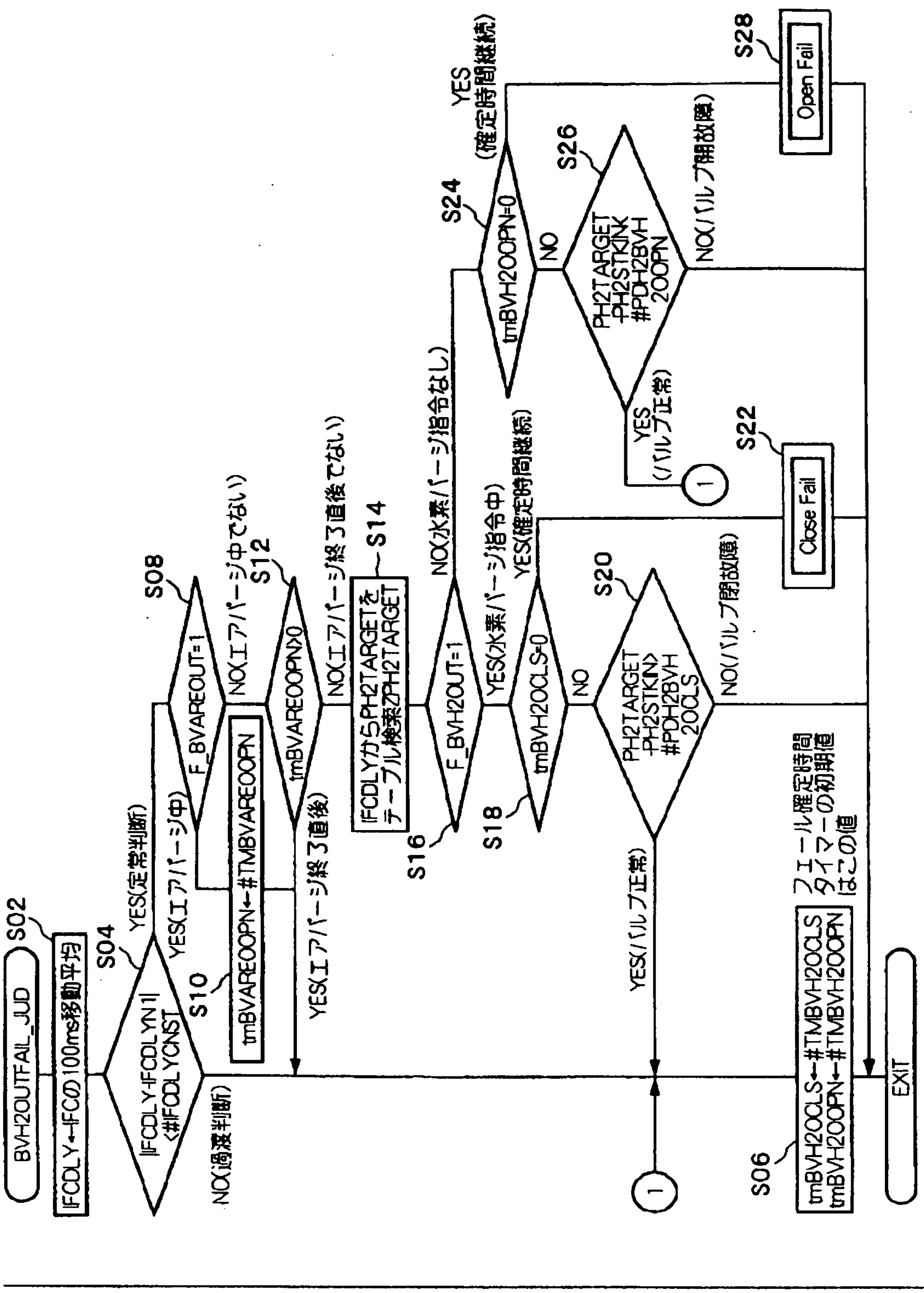
[Drawing 1]



[Drawing 3]



[Drawing 2]



[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 1st partition of the 7th section
[Publication date] August 4, Heisei 17 (2005. 8.4)

[Publication No.] JP,2003-92125,A (P2003-92125A)
[Date of Publication] March 28, Heisei 15 (2003. 3.28)
[Application number] Application for patent 2002-84445 (P2002-84445)
[The 7th edition of International Patent Classification]

```
H01M  8/04
H01M  8/06
// H01M  8/10
```

[FI]

```
H01M  8/04      H
H01M  8/04      J
H01M  8/06      R
H01M  8/10
```


[Procedure revision]
[Filing Date] January 4, Heisei 17 (2005. 1.4)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1]
Fuel cell,
A fuel-supply means to have an exhaust air fuel circulation means to carry out recycling of the exhaust air hydrogen which supplies hydrogen to this fuel cell from a hydrogen bomb, and is discharged from the fuel exhaust air section of this fuel cell to the fuel air-supply section of this fuel cell,
An oxidizer supply means to supply an oxidizer to this fuel cell,
The reactant gas amount-of-supply adjustment device which adjusts the oxidizer amount of supply from this oxidizer supply means to this fuel cell, and the fuel amount of supply from said fuel-supply means to this fuel cell,
A demand output current decision means to determine the demand output current of this fuel cell according to the demand of this load in case this fuel cell is connected with a load and power is supplied to this load,
The reactant gas amount-of-supply control means which controls the reactant gas amount of supply to said fuel cell by said reactant gas amount-of-supply accommodation means so that said demand output current is acquired,
A hydrogen discharge means to discharge exhaust air hydrogen to the exterior of a fuel cell on a fuel exhaust air circulating flow way,
It is the fuel cell control unit equipped with a fuel cell judging means to detect the output state of said fuel

cell and to output a hydrogen discharge command to said hydrogen discharge means according to said condition of having detected,
A transient judging means by which the range of fluctuation of the generated output of said fuel cell within convention time amount judges whether it is convention within the limits,
A hydrogen discharge command detection means to detect the existence of the hydrogen discharge command to a hydrogen discharge means,
The fault detection means of a hydrogen discharge means to judge failure of said hydrogen discharge means based on the target preassure force and detection value of said fuel air-supply section,
a **** beam -- the fuel cell control unit characterized by things.
[Claim 2]
The fuel cell control unit according to claim 1 characterized by establishing an alarm generating means to generate the alarm of open failure or closed failure either when said fault detection means detects failure of said hydrogen discharge means.
[Claim 3]
The fuel cell control unit according to claim 2 characterized by establishing a load limitation means to restrict the upper limit of the demand generation-of-electrical-energy output to a fuel cell to below default value according to the closed failure alarm of said alarm generating means.
[Claim 4]
The fuel cell control unit according to claim 2 characterized by to establish the fuel exhaust air circulating flow way closedown means which closes said fuel exhaust air circulating flow way between a fuel exhaust air circulation means and said hydrogen discharge means according to the open failure alarm of said alarm generating means while establishing a load-limitation means restrict the upper limit of the output request to a fuel cell to below default value according to the open failure alarm of said alarm generating means.
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0004
[Method of Amendment] Modification
[The contents of amendment]
[0004]
[Means for Solving the Problem]
In order to solve the above-mentioned technical problem, invention indicated to claim 1 To a fuel cell (for example, fuel cell stack 22 in an operation gestalt), and this fuel cell, a hydrogen bomb Hydrogen is supplied from (for example, the high-pressure hydrogen tank 30 in an operation gestalt). An exhaust air fuel circulation means to carry out recycling of the exhaust air hydrogen discharged from the fuel exhaust air section of this fuel cell to the fuel air-supply section of this fuel cell A fuel-supply means to have (for example, the ejector 36 in an operation gestalt) (for example, regulator 34 in an operation gestalt), An oxidizer supply means to supply an oxidizer to this fuel cell (for example, supercharger 44 in an operation gestalt), The reactant gas amount-of-supply adjustment device which adjusts the oxidizer amount of supply from this oxidizer supply means to this fuel cell, and the fuel amount of supply from said fuel-supply means to this fuel cell (for example, demand/supply capability calculation section 94 in an operation gestalt), A demand output current decision means to determine the demand output current of this fuel cell according to the demand of this load in case this fuel cell is connected with a load and power is supplied to this load (for example, energy management section 8 in an operation gestalt), The reactant gas amount-of-supply control means which controls the reactant gas amount of supply to said fuel cell by said reactant gas amount-of-supply adjustment device so that said demand output current is acquired (for example, regulator 34 in an operation gestalt), A hydrogen discharge means to discharge exhaust air hydrogen to the exterior of a fuel cell on a fuel exhaust air circulating flow way (for example, hydrogen outflow way 60b in an operation gestalt, the hydrogen purge valve 66), A fuel cell judging means to detect the output state of said fuel cell and to output a hydrogen discharge command to said hydrogen discharge means according to said condition of having detected (for example, fuel cell control section 100 in an operation gestalt), It is a preparation ********** control unit. The range of fluctuation of the generated output of said fuel cell within convention time amount A transient judging means to judge whether it is convention within the limits (for example, processings S04, S08, and S12, in the hydrogen purge valve fault detection section 90 in an operation gestalt), A hydrogen discharge command detection means to detect the existence of the hydrogen discharge command to a hydrogen discharge means (for example, processing S16, in the hydrogen purge valve fault detection section 90 in an operation gestalt), It is characterized by establishing the fault detection means (for

example, processings S20 and S26 in the hydrogen purge valve fault detection section 90 in an operation gestalt) of a hydrogen discharge means to judge failure of said hydrogen discharge means based on the target preassure force and detection value of said fuel air-supply section.
Thus, with constituting, when a hydrogen discharge means is closed failure (failure which does not open), or open failure (failure which is not closed), it can detect certainly. Moreover, since the failure judging of a hydrogen discharge means is not performed when it judges with a transient in said transient judging means, the dependability of a failure judging can be raised.
In addition, a timer style is prepared, and when the condition of having been judged with closed failure or open failure carries out fixed time amount continuation, you may make it judge failure of a hydrogen discharge means for said fault detection means. Moreover, change (the amount of treading in of an accelerator pedal) of the amount required of the demand power generating section can be included in the decision criterion of the transient judged with said transient judging means.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0005
[Method of Amendment] Modification
[The contents of amendment]
[0005]
Invention indicated to claim 2 is characterized by establishing an alarm generating means (for example, hydrogen purge valve fault detection section 90 in an operation gestalt) to generate the alarm of open failure or closed failure either, when said fault detection means detects failure of said hydrogen means.
Thus, with constituting, when a hydrogen discharge means is closed failure (failure which does not open), or open failure (failure which is not closed), it can detect certainly whether it is failure [which].
Invention indicated to claim 3 is characterized by establishing a load limitation means (for example, limiter 92 in an operation gestalt) to restrict the upper limit of the output request to a fuel cell to below default value according to the closed failure alarm of said alarm generating means.
Thus, with constituting, even when a hydrogen discharge means is closed failure, the generation-of-electrical-energy capacity of a fuel cell is made to hold in the fixed range, and operation can be performed continuously. At this time, by operating in the low-power output region where the utilization factor of hydrogen is low, the amount of supply of hydrogen can be stopped and the amount of generation water can be stopped.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0006
[Method of Amendment] Modification
[The contents of amendment]
[0006]
While invention according to claim 4 establishes a load limitation means to restrict the upper limit of the output request to a fuel cell to below default value according to the open failure alarm of said alarm generating means It responds to the open failure alarm of said alarm generating means. Said fuel exhaust air circulating flow way between said fuel exhaust air circulation means and said hydrogen discharge means It is characterized by establishing the fuel exhaust air circulating flow way closedown means (for example, on-off control valve 64 in an operation gestalt) which closes (for example, hydrogen circulating flow way 60a in an operation gestalt).
Thus, since it is lost that said fuel exhaust air circulating flow way turns into a bypass way in parallel with a fuel cell, and the hydrogen of a hydrogen feeder current way is discharged from this bypass way with constituting when a hydrogen discharge means is open failure, useless discharge of hydrogen can be prevented.
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0026
[Method of Amendment] Modification
[The contents of amendment]
[0026]
[Effect of the Invention]
Since there is no change in the abnormalities in a pressure occurring when according to invention indicated

to claim 1 open failure of is done and a hydrogen discharge means will be [closed failure or] the mechanical cause if it is the electric cause as explained above, closed failure or open failure of a hydrogen discharge means is detectable regardless of a cause. Moreover, since the failure judging of a hydrogen discharge means is not performed when it judges with a transient in said transient judging means, incorrect recognition of a failure judging can be eliminated.
Moreover, according to invention indicated to claim 2, when a hydrogen discharge means is closed failure (failure which does not open), or open failure (failure which is not closed), it can detect certainly whether it is failure [which].
[Procedure amendment 6]
[Document to be Amended] Specification
[Item(s) to be Amended] 0027
[Method of Amendment] Modification
[The contents of amendment]
[0027]
Moreover, even when a hydrogen discharge means is closed failure, the yield of the generation water at the time of a generation of electrical energy can be made into the minimum, and the generation-of-electrical-energy capacity of a fuel cell can be made to hold in the fixed range according to invention indicated to claim 3.
[Procedure amendment 7]
[Document to be Amended] Specification
[Item(s) to be Amended] 0028
[Method of Amendment] Modification
[The contents of amendment]
[0028]
Moreover, since according to invention indicated to claim 4 it is lost that it is discharged via a fuel exhaust air circulating flow way before the hydrogen supplied from a fuel-supply means is supplied to a fuel cell even when a hydrogen discharge means is open failure, useless discharge of hydrogen can be prevented.

[Translation done.]

①

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号
特開2003－92125
（P2003－92125A）
(43)公開日　平成15年3月28日(2003.3.28)

(51)Int.Cl.7	識別記号	F I	テーマコート゛(参考)
ＨＯ１Ｍ　8/04		ＨＯ１Ｍ　8/04	Ｈ　５Ｈ０２６
			Ｊ　５Ｈ０２７
8/06		8/06	Ｒ
// ＨＯ１Ｍ　8/10		8/10	

審査請求　未請求　請求項の数３　ＯＬ　（全　９　頁）

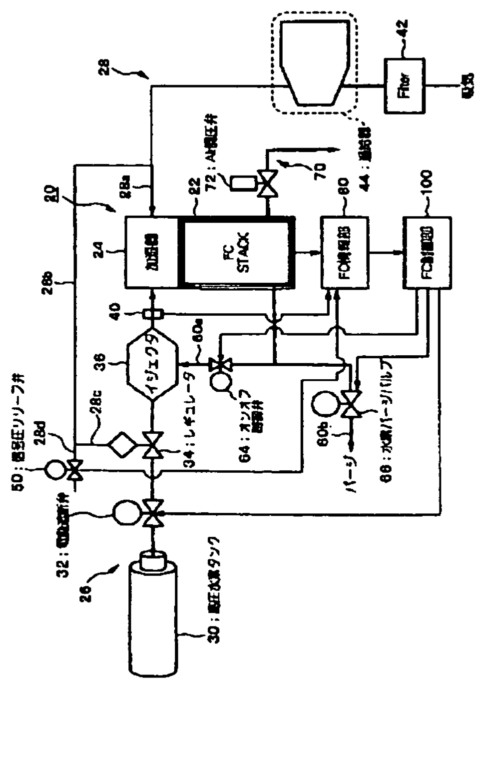
(21)出願番号　特願2002－84445(P2002－84445)
(22)出願日　平成14年3月25日(2002.3.25)
(31)優先権主張番号　特願2001－209832(P2001－209832)
(32)優先日　平成13年7月10日(2001.7.10)
(33)優先権主張国　日本（ＪＰ）

(71)出願人　000005326
本田技研工業株式会社
東京都港区南青山二丁目１番１号
(72)発明者　上田　健一郎
埼玉県和光市中央１丁目４番１号　株式会社本田技術研究所内
(72)発明者　村上　義一
埼玉県和光市中央１丁目４番１号　株式会社本田技術研究所内
(74)代理人　100064908
弁理士　志賀　正武　（外５名）

最終頁に続く

(54)【発明の名称】　燃料電池制御装置

(57)【要約】
【課題】　水素パージバルブの故障を、機械的原因あるいは電気的原因に関わらず、検知することができる燃料電池制御装置を提供する。
【解決手段】　燃料電池スタック２２の発電出力変動が規定範囲内であるかを判定する過渡状態判定手段と、水素パージバルブ６６のパージ指令の有無を検知する水素パージ指令検知部と、アノードの目標圧力値と実際値とを比較して水素パージバルブの開故障及び閉故障を判定する故障判定部と、当該故障判定部の判定結果に応じた警報信号を発生する警報発生手段と、を設けたことを特徴とする。



【特許請求の範囲】

【請求項１】 燃料電池と、

該燃料電池に水素ボンベから水素を供給し、該燃料電池の燃料排気部から排出される排気水素を該燃料電池の燃料給気部に再循環させる排気燃料循環手段を有する燃料供給手段と、

該燃料電池に酸化剤を供給する酸化剤供給手段と、

該酸化剤供給手段から該燃料電池への酸化剤供給量及び前記燃料供給手段から該燃料電池への燃料供給量を調節する反応ガス供給量調整手段と、

該燃料電池を負荷と接続して該負荷に電力を供給する際に該負荷の要求に応じて該燃料電池の要求出力電流を決定する要求出力電流決定手段と、

前記要求出力電流が得られるように前記反応ガス供給量調節手段によって前記燃料電池への反応ガス供給量を制御する反応ガス供給量制御手段と、

前記燃料排気部と燃料循環手段を接続する燃料排気循環流路に排気水素を燃料電池の外部へ排出する水素排出手段と、

前記燃料電池の出力状態を検出して、前記検出した状態に応じて前記水素排出手段に水素排出指令を出力する燃料電池判定手段と、を備えた燃料電池制御装置であって、

規定時間内の前記燃料電池の発電電力の変動幅が、規定範囲内であるかを判定する過渡状態判定手段と、

水素排出手段への水素排出指令の有無を検知する水素排出指令検知手段と、

前記燃料給気部の目標圧力と検出値とに基づいて前記水素排出手段の故障を判定する水素排出手段の故障検出手段と、

当該故障検出手段で前記水素排出手段の故障を検出した場合に、開故障又は閉故障のいずれかの警報を発生する警報発生手段と、を設けたことを特徴とする燃料電池制御装置。

【請求項２】 前記警報発生手段の閉故障警報に応じて燃料電池への要求発電出力の上限値を規定値以下に制限する出力制限手段を設けたことを特徴とする請求項１に記載の燃料電池制御装置。

【請求項３】 前記警報発生手段の開故障警報に応じて燃料電池への出力要求の上限値を規定値以下に制限する出力制限手段を設けるとともに、前記警報発生手段の開故障警報に応じて燃料排気循環手段と前記水素排出手段との間の前記燃料排気循環流路を閉じる燃料排気循環流路閉止手段を設けることを特徴とする請求項１に記載の燃料電池制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、燃料電池自動車用に適用される燃料電池制御装置に係り、特に、燃料電池の水素排出流路に設けられる水素パージバルブの故障を検知する燃料電池制御装置に関するものである。

【０００２】

【従来の技術】ＰＥＭ型燃料電池セルを、複数直列に積層した燃料電池スタックのアノードに燃料（水素）を、カソードに酸化剤（空気）を供給することで、起電力を得ることができる。前記燃料電池は、水素と酸素の反応により電力と水が生成され、この生成水が水滴となって燃料電池セルの反応ガス流路内に滞留すると、反応ガス流路をふさぎ、セル出力電圧の低下を招く。この現象は、フラッディングと称され、これを防止または解消するために、燃料電池が一定電力量又は一定の時間発電したら、あるいはセル電圧が規定の電圧以下に低下したときに、生成水を外部に排出する。また、生成水が水滴化し、反応ガス流路をふさぐと、水溜まり以後に反応ガスが供給されなくなる為に、部分的にガス欠が発生し、固体高分子電解質膜にダメージを与えて、性能低下を生ずる。上記した生成水の排出を行うために、加圧水素循環型の燃料電池システムのアノードガス排気流路には水素パージバルブが設けられており、この水素パージバルブを開くことにより前記生成水を燃料電池から外部に排出する。

【０００３】

【発明が解決しようとする課題】上記したように、水素パージバルブは燃料電池システムが機能を維持する上で非常に重要な役割を担っている。そこで、この発明は、水素パージバルブの故障を検知することができる燃料電池制御装置を提供するものである。また、この発明は、水素パージバルブが閉故障または開故障の場合に燃料電池システムの運転を円滑に行うことができる燃料電池制御装置を提供するものである。

【０００４】

【課題を解決するための手段】上記課題を解決するために、請求項１に記載した発明は、燃料電池（例えば、実施形態における燃料電池スタック２２）と、該燃料電池に水素ボンベ（例えば、実施形態における高圧水素タンク３０）から水素を供給し、該燃料電池の燃料排気部から排出される排気水素を該燃料電池の燃料給気部に再循環させる排気燃料循環手段（例えば、実施形態におけるイジェクタ３６）を有する燃料供給手段（例えば、実施形態におけるレギュレータ３４）と、該燃料電池に酸化剤を供給する酸化剤供給手段（例えば、実施形態における過給器４４）と、該酸化剤供給手段から該燃料電池への酸化剤供給量及び前記燃料供給手段から該燃料電池への燃料供給量を調節する反応ガス供給量調整手段（例えば、実施形態における要求／供給可能出力算出部９４）と、該燃料電池を負荷と接続して該負荷に電力を供給する際に該負荷の要求に応じて該燃料電池の要求出力電流を決定する要求出力電流決定手段（例えば、実施形態におけるエネルギーマネジメント部８）と、前記要求出力電流が得られるように前記反応ガス供給量調整手段によ

って前記燃料電池への反応ガス供給量を制御する反応ガス供給量制御手段（例えば、実施形態におけるレギュレータ３４）と、前記燃料排気部と燃料循環手段を接続する燃料排気循環流路に排気水素を燃料電池の外部へ排出する水素排出手段（例えば、実施形態における水素排出流路６０ｂ、水素パージバルブ６６）と、前記燃料電池の出力状態を検出して、前記検出した状態に応じて前記水素排出手段に水素排出指令を出力する燃料電池判定手段（例えば、実施形態における燃料電池制御部１００）と、を備えた燃料電池制御装置であって、規定時間内の前記燃料電池の発電電力の変動幅が、規定範囲内であるかを判定する過渡状態判定手段（例えば、実施形態における水素パージバルブ故障検出部９０での処理Ｓ０４、Ｓ０８、Ｓ１２）と、水素排出手段への水素排出指令の有無を検知する水素排出指令検知手段（例えば、実施形態における水素パージバルブ故障検出部９０での処理Ｓ１６）と、前記燃料給気部の目標圧力と検出値とに基づいて前記水素排出手段の故障を判定する水素排出手段の故障検出手段（例えば、実施形態における水素パージバルブ故障検出部９０での処理Ｓ２０、Ｓ２６）と、当該故障検出手段で前記水素手段の故障を検出した場合に、開故障又は閉故障のいずれかの警報を発生する警報発生手段（例えば、実施形態における水素パージバルブ故障検出部９０）と、を設けたことを特徴とする。このように構成することで、水素排出手段が閉故障（開弁しない故障）または開故障（閉弁しない故障）の場合に確実に検知することができる。また、前記過渡状態判定手段において過渡状態と判定した場合には水素排出手段の故障判定は行わないため、故障判定の信頼性を高めることができる。なお、前記故障検出手段には、タイマ機構を設けて、閉故障あるいは開故障と判定された状態が一定時間継続した時に、水素排出手段の故障を判定するようにしてもよい。また、前記過渡状態判定手段で判定する過渡状態の判断基準には、要求電力発生部の要求量の変化（アクセルペダルの踏み込み量）を含めることができる。

【０００５】請求項２に記載した発明は、前記警報発生手段の閉故障警報に応じて燃料電池への出力要求の上限値を規定値以下に制限する出力制限手段（例えば、実施形態におけるリミッタ９２）を設けたことを特徴とする。このように構成することで、水素排出手段が閉故障であった場合でも、燃料電池の発電能力を一定範囲で保持させて運転を継続して行うことができる。このとき、水素の利用率の低い低出力域で運転を行うことで、水素の供給量を抑えて生成水の量を抑えることができる。

【０００６】請求項３に記載の発明は、前記警報発生手段の開故障警報に応じて燃料電池への出力要求の上限値を規定値以下に制限する出力制限手段を設けるとともに、前記警報発生手段の開故障警報に応じて前記燃料排気循環手段と前記水素排出手段との間の前記燃料排気循環流路（例えば、実施形態における水素循環流路６０ａ）を閉じる燃料排気循環流路閉止手段（例えば、実施形態におけるオンオフ制御弁６４）を設けたことを特徴とする。このように構成することで、水素排出手段が開故障であった場合、前記燃料排気循環流路が燃料電池と並列なバイパス路となって水素供給流路の水素がこのバイパス路から排出されることがなくなるため、水素の無駄な排出を防止することができる。

【０００７】

【発明の実施の形態】以下、この発明の実施形態における燃料電池制御装置を図面と共に説明する。図１はこの発明の実施形態における燃料電池システム２０の制御装置を示す概略構成図である。燃料電池スタック（燃料電池）２２は、固体高分子膜をアノード側拡散電極とカソード側拡散電極とで挟持してなる燃料電池セルを、複数積層させて一体化させた構造となっている。前記燃料電池スタック２２には、水素供給流路２６及びエア（酸素）供給流路２８が接続した加湿器２４が設けてあり、当該加湿器２４を介して前記燃料電池スタック２２にそれぞれのガス（水素、エア）が供給されるようになっている。

【０００８】まず、水素供給流路２６について説明する。水素供給流路２６には水素供給源である高圧水素タンク３０が設けられており、水素供給流路２６に高圧の水素を供給できるようにしている。また、前記高圧水素タンク３０側の水素供給流路２６には電動遮断弁３２が設けてあり、当該電動遮断弁３２の開閉動作により水素の供給停止制御を行うようにしている。前記電動遮断弁３２の下流側にはレギュレータ３４が設けてある。前記レギュレータ３４は、詳細を後述するエア供給流路２８ｃに接続してあり、エアの圧力に応じて水素供給流路２６の水素圧力を調整できるようにしている。前記レギュレータ３４の下流側には、イジェクタ３６が設けてある。前記イジェクタ３６は、詳細を後述する水素循環流路６０ａに接続してある。前記イジェクタ３６は、前記水素循環流路６０ａの水素を負圧により吸い込んで、この吸い込んだ水素を前記イジェクタ３６下流側の水素供給流路２６に送り出すようにしている。水素供給流路２６は前記イジェクタ３６下流側で前記加湿器２４に接続しており、前記水素供給流路２６内の水素はこの加湿器２４にて適度な湿度に加湿された後、燃料電池スタック２２のアノード側に供給される。そして、本実施形態においては、イジェクタ３６下流側に、圧力センサ４０が設けてあり、当該圧力センサ４０にて前記水素供給流路２６の水素圧力を測定できるようにしている。

【０００９】次に、エア（酸素）供給流路２８について説明する。エア供給流路２８には、上流側にフィルタ４２が設けてあり、当該フィルタ４２にてエアの塵埃を除去させている。前記フィルタ４２の下流側には過給器４４が設けてあり、当該過給器４４にてエアの供給圧力を

調整することができるようにしている。エア供給流路２８は、エア供給流路２８ａ、２８ｂに分岐している。一方のエア供給流路２８ａは前記加湿器２４に接続しており、前記エア供給流路２８ａ内のエアはこの加湿器２４にて適度な湿度に加湿された後、燃料電池スタック２２のカソード側に供給される。他方のエア供給流路２８ｂは、さらにエア供給流路２８ｃ、２８ｄに分岐して、前記エア供給流路２８ｃは前記レギュレータ３４に接続するとともに、前記エア供給流路２８ｄには信号圧リリーフ弁５０が設けてあり、前記信号圧リリーフ弁５０にてエア供給流路２８ｄ内のエア圧力を測定している。水素圧力はレギュレータ３４に供給されるエアの圧力を信号圧として、前記レギュレータ３４を通過した水素の圧力が前記エア圧力に応じた所定範囲の圧力となるように調整することができる。このため、燃料電池スタック２２における極間差圧を適正範囲に調整することができる。

【００１０】燃料電池スタック２２のアノード側拡散電極の反応面に水素が供給されると、ここで水素がイオン化され、固体高分子電解質膜を介してカソード電極側に移動する。この間に生じた電子が外部回路に取り出され、直流の電気エネルギーとして利用される。カソード電極には酸素が供給されているため、水素イオン、電子、及び酸素が反応して水が生成される。発電後の水素及び酸素は、それぞれ水素排出流路６０及びエア排出流路７０から燃料電池スタック２２外部に排出される。以下これらについて説明する。

【００１１】水素排出流路６０について説明する。水素排出流路６０は水素循環流路６０ａと水素排出流路６０ｂとに分岐している。水素循環流路６０ａは、前記イジェクタ３６に接続しており、当該水素流路６０ａ内の水素を前記イジェクタ３６に供給できるようにしている。このため、未反応のまま水素排出流路６０に排出された水素を燃料電池スタック２２に再度循環させて供給している。前記水素循環流路６０ａには、オンオフ制御弁６４が設けてあり、当該オンオフ制御弁６４は電気信号により水素循環流路６０ａの開閉を行わせるようにしている。

【００１２】他方の水素排出流路６０ｂは、水素パージバルブ６６が設けてあり、当該水素パージバルブ６６を開くことにより水素パージや極間差圧の調整が行えるようにしている。なお、燃料電池システム２０の通常発電時には、前記パージバルブ６６を閉じるとともに、オンオフ制御弁６４を開いておき、水素を外部に排出することなく、水素を循環させて発電を行わせている。エア排出流路７０について説明する。エア排出流路７０には、エア調圧弁７２が設けてあり、エア調圧弁７２を開閉することで圧力調整を行わせることができる。燃料電池スタック２２には、燃料電池情報部（ＦＣ情報部）８０が電気的に接続し、ここに燃料電池スタック２２における各燃料電池セルごとの電流値や電圧値、燃料電池スタック２２全体での電流値や電圧値が入力される。さらに、前記燃料電池情報部８０は、前記電動遮断弁３２、信号圧リリーフ弁５０に電気的に接続し、水素圧力やエア圧力、燃料電池スタック８０の温度等も入力されるのである。

【００１３】そして、本実施形態においては、燃料電池制御部（ＦＣ制御部）１００が設けてある。前記燃料電池制御部１００には、図３に示したように、前記燃料電池情報部８０に接続した水素パージバルブ故障検出部９０が設けてあり、この水素パージバルブ故障検出部９０において、水素パージバルブ６６の故障判断を行うのである。前記水素パージバルブ故障検出部９０は、燃料電池スタック２２の発電出力変動が規定範囲内であるかを判定する過渡状態判定手段と、アノードの目標圧力値と検出値とに基づいて水素パージバルブ６６の開故障及び閉故障を判定する故障判定部と、当該故障判定部で開故障又は閉故障を判定した場合に警報を発生する警報発生手段とを備えている。

【００１４】図２はこの発明の実施形態における水素パージバルブ故障検知の処理フローである。まず、前記ＦＣ情報部８０で検知したＩＦＣ（燃料電池発電電流）値の移動平均ＩＦＣＤＬＹを算出する（Ｓ０２）。本実施形態においては、前記ＩＦＣＤＬＹはＩＦＣの１００ｍｓｅｃでの移動平均であり、各ＩＦＣＤＬＹを１０ｍｓごとに算出している。そして、最新のＩＦＣ値の移動平均ＩＦＣＤＬＹと、その直前の移動平均ＩＦＣＤＬＹＮ１との差分をとり、この差分を設定値＃ＩＦＣＤＬＹＮＳＴより小さいかどうかを判断する（Ｓ０４）。前記差分が設定値より大きいとき（ＮＯのとき）には、急激な過渡状態であるため水素パージバルブ６６の故障検知についての判断は行わず、閉故障判断の基準となるフェール確定時間（ｔｍＢＶＨ２ＯＣＬＳ）、開故障判断の基準となるフェール確定時間（ｔｍＢＶＨ２ＯＯＰＮ）をそれぞれ設定して（Ｓ０６）、一旦故障検知処理のフローを終了する。このような急激な過渡状態の原因には、例えばアクセルの急激な踏み込み等が考えられるが、このような場合に水素パージバルブ６６の故障検知を行わないことで、故障判定の信頼性を高めることができる。このステップで設定されたフェール確定時間がタイマ初期値となる。また、このフローは減算回路となっており、一旦フローを終了して再度やり直すときには、設定したタイマ値（例えば、上記フェール確定時間など）から一定値が減算される。これについては、詳細を後述する。

【００１５】Ｓ０６において、前記差分が設定値より小さいとき（ＹＥＳのとき）には、エアパージが行われているか、すなわち信号圧リリーフ弁５０が開いているかどうかを判断する（Ｓ０８）。Ｓ０８において、エアパージ中と判断したとき（ＹＥＳのとき）であれば、エアパージのタイマ値（ｔｍＢＶＡＲＥＯＰＮ）を設定した

後、上記したＳ０６の処理を行い、一旦故障検知処理のフローを終了する。上記したように水素圧力は、前記レギュレータ３４にてエア圧力に基づいて調整されるため、エアパージによるエア側の圧力低下に伴い水素側も圧力が低下する。このため、エアパージ中であれば、水素パージバルブ６６の故障検知を行わずに、故障検知の信頼性をより高めている。

【００１６】Ｓ０８において、エアパージ中ではないと判断したとき（ＮＯのとき）には、さらに、エアパージ終了直後かどうかを判断する（Ｓ１２）。この判断は、上記したタイマ値（ｔｍＢＶＡＲＥＯＰＮ）が0より大きいかどうかで判断する。Ｓ１２において、エアパージ終了直後と判断したとき（ＹＥＳのとき）には、水素パージバルブ６６の故障検知は行わず、上記したＳ０６の処理をした後、一旦故障検知処理のフローを終了する。Ｓ１２において、エアパージ終了直後でないと判断したとき（ＮＯのとき）には、水素パージバルブ６６の故障判定処理を行う。このようにしたため、故障検知の信頼性をさらに一層高めることができる。なお、本実施形態においては信号圧リリーフ弁５０でエアパージを行う場合について説明したが、信号圧リリーフ弁５０がない場合またはエアパージを行わない場合においては、上記したＳ０８～Ｓ１２の処理は省略することができる。

【００１７】水素パージバルブ６６の故障判定処理について説明する。まず、上記したＩＦＣＤＬＹに基づいて、想定水素圧力（ＰＨ２ＴＡＲＧＥＴ）を算出する（Ｓ１４）。本実施形態においては、ＩＦＣＤＬＹと想定水素圧力との関係特性をテーブルデータとして保持しており、前記ＩＦＣＤＬＹに対応する想定水素圧力を前記テーブルデータから算出している。そして、水素パージ指令の有無を判定し（Ｓ１６）、水素パージ指令が出ている場合（ＹＥＳの場合）には閉故障の判断を行い、水素パージ指令が出ていない場合（ＮＯの場合）には開故障の判断を行う。なお、実施形態においては、関係特性をテーブルデータで保持した場合について説明したが、これに限らず、例えば演算式から想定水素圧力を算出してもよい。

【００１８】水素パージ指令がある場合について説明する。まず、閉故障のフェール確定時間（ｔｍＢＶＨ２ＯＣＬＳ）の値が0かどうかを判定する（Ｓ１８）。Ｓ１８において、上記フェール確定時間が０になっていないとき（ＮＯのとき）、閉故障かどうかの判定を行う。本実施形態においては、前記想定水素圧力と、圧力センサ４０で測定した実際の水素圧力（ＰＨ２ＳＴＫＩＮ）との差分をとり、この差分が設定値（＃ＰＤＨ２ＢＶＨ２ＯＣＬＳ）より大きいかを判断する（Ｓ２０）。水素パージ指令により水素パージバルブ６６が開いている場合には、実際の圧力は想定圧力よりも設定値より下がるはずである。従って、Ｓ２０において差圧が設定値より大きいとき（ＹＥＳのとき）には、水素パージバルブ６６は正常であると判断され、上記したＳ０６の処理を行った後、一旦故障検知処理のフローを終了する。そして、Ｓ２０において差圧が設定値より小さいとき（ＮＯのとき）には、差圧がほとんとないことから水素パージバルブ６６は閉故障であると判断され、故障検知処理のフローを終了する。このフロー終了時に、上記した閉故障に対するフェール確定時間の値から一定値を減算する。従って、上記処理を繰り返して、フェール確定時間の値が０になったとき、Ｓ１８において一定時間閉故障の状態が続いたと判断され、水素パージバルブ６６の閉故障の判定（Ｃｌｏｓｅ　Ｆａｉｌ）が確定する（Ｓ２２）。

【００１９】水素パージ指令がない場合について説明する。まず、開故障のフェール確定時間（ｔｍＢＶＨ２ＯＯＰＮ）の値が0かどうかを判定する（Ｓ２４）。Ｓ２４において、上記フェール確定時間が０になっていないとき（ＮＯのとき）、開故障かどうかの判定を行う。本実施形態においては、前記想定水素圧力と、圧力センサ４０で測定した実際の水素圧力（ＰＨ２ＳＴＫＩＮ）との差分をとり、この差分が設定値（＃ＰＤＨ２ＢＶＨ２ＯＯＰＮ）より小さいかを判断する（Ｓ２６）。水素パージ指令がないため水素パージバルブ６６は閉じているはずであり、実際の圧力は想定圧力とほぼ同じ値となるはずである。従って、Ｓ２６において差圧が設定値より小さいとき（ＹＥＳのとき）には、水素パージバルブ６６は正常であると判断され、上記したＳ０６の処理を行った後、一旦故障検知処理のフローを終了する。そして、Ｓ２６において差圧が設定値より大きいとき（ＮＯのとき）には、差圧が大きすぎることから水素パージバルブ６６は開故障であると判断され、故障検知処理のフローを終了する。このとき、上記した開故障に対するフェール確定時間の値から一定値が減算してある。従って、上記処理を繰り返して、フェール確定時間の値が０になったとき、Ｓ１８において一定時間開故障の状態が続いたと判断され、水素パージバルブ６６の開故障の判定が確定する（Ｓ２８）。このように構成することで、水素パージバルブが閉故障または開故障した場合には、電気的原因であろうと機械的な原因であろうと、圧力異常が発生することに変わりはないため、原因の如何に関わらず水素パージバルブ６６の閉故障あるいは開故障を検知することができる。

【００２０】以下、水素パージバルブ６６の開故障あるいは閉故障を検知した場合の制御について説明する。前記燃料電池情報部８０は燃料電池制御部１００に接続しており、当該燃料電池制御部１００は燃料電池情報部８０からの情報に基づき燃料電池システム２０の制御を行えるようにしている。図１に示したように、前記燃料電池制御部１００は、電動遮断弁３２、水素パージバルブ６６、オンオフ制御弁６４に電気的に接続しており、それぞれの弁３２、６６、６４の開閉制御を行えるようにしている。

【００２１】まず、閉故障を検知した場合には、前記燃料電池制御部１００からの指令を通じて、燃料電池スタック２２での出力上限を設定する。これについては詳細を後述する。また、燃料電池制御部１００で電動遮断弁３２の開度を調整することにより、高圧水素タンク３０から供給する水素を最小限度として、水素のストイキを高く維持できる低出力域で運転を行う。ここで、水素のストイキとは、燃料電池スタックで消費された水素量（ＱＨ１）に対する燃料電池スタックに供給された水素量（ＱＨ０）の比（ＱＨ０／ＱＨ１）を言う。消費された水素量一定（発電電流一定）の時には、ストイキは供給水素量に比例し、ストイキが低下すれば水素ガスの供給流量が低下することとなり、水素ガスの供給流量の低下に従って発電電流が低下することとなる。このため、上記したようにストイキを高くすることで水素ガスの供給流量を抑えて、燃料電池スタック内に溜まる生成水を最小限に抑えることができる。さらに、エアのストイキを上昇させることで、生成水のカソード側からアノード側への逆浸透を減らし、アノード電極側に滞留する生成水の増加を防ぐことができる。

【００２２】次に、開故障を検知した場合について説明する。このときには、上記した閉故障の場合と同様にリミッタ９２で制限するとともに、オンオフ制御弁６４を前記燃料電池制御部１００からの電気信号によりオフに設定して、前記水素循環流路６０ａの流通を遮断する。これにより、水素がイジェクタ３６の吸引部を逆流して水素循環流路６０ａを介して水素パージバルブ６６から外部に排出され供給されることを防止して、水素供給流路２６からの水素が確実に燃料電池スタック２２に供給することができる。また、燃料電池スタック２２での上限出力を制限することで、供給される水素を無駄に放出することを最小限に抑えることができる。

【００２３】図３は、この発明の実施形態における燃料電池制御装置を搭載した燃料電池自動車１の要部を示す構成図である。前記燃料電池自動車１では、燃料電池スタック２２やキャパシタ３が、補機４と、モータ６に接続したインバータ５とに対して並列に設けられ、燃料電池スタック２２やキャパシタ３から電力が供給される。また、前記燃料電池スタック２２には、反応ガス供給装置（反応ガス供給流路）２６、２８が接続してあり、反応ガス（水素、エア）が燃料電池スタック２２に供給される。

【００２４】前記インバータ５はモータコントロール部７に接続している。モータコントロール部７は、入力データから要求電力量を算出して、前記モータ６の駆動に必要な電力を算出する。前記データには、アクセルペダルの踏み込み量（Ａｐ）や、モータ６の回転数（Ｎｍ）、電流（Ｉｍ）、電圧（Ｖｍ）がある。前記モータコントロール部７はエネルギーマネジメント部８に接続し、当該エネルギーマネジメント部８に前記要求電力量を伝達する。エネルギーマネジメント部８は、キャパシタ３からの放電可能量を算出するとともに、燃料電池スタック２２における目標発電量を算出する。前記エネルギーマネジメント部８は、燃料電池制御部１００に接続しており、燃料電池制御部１００に発電指示値を伝達できるようになっている。前記発電指示値は、水素パージバルブ６６（図１参照）での故障を検知しないときには、前記燃料電池制御部１００の要求／供給可能出力算出部９４に入力される。前記要求／供給可能出力算出部９４は、反応ガス供給装置２６、２８に信号を送り、燃料電池スタック２２に反応ガスを供給して発電をさせる。燃料電池スタック２２は燃料電池情報部８０に接続して、当該燃料電池情報部８０に出力値算出に必要なデータを入力する。前記燃料電池情報部８０は前記要求／供給可能出力算出部９４に接続して、前記データを送信する。そして、要求／供給可能出力演算部９４は、燃料電池スタック２２の出力限界値をエネルギーマネジメント部８に送信する。エネルギーマネジメント部８は上記限界値をモータコントロール部７に送信し、出力値を制限できるようにしている。

【００２５】燃料電池制御部１００には、水素パージバルブ故障検出部９０、リミッタ９２、入力切り換え部９３を有しており、前記水素パージバルブ故障検出部９０は燃料電池情報部８０に接続している。前記燃料電池情報部８０からの情報で、前記水素パージバルブ故障検出部９０で故障を検知した場合には、エネルギーマネジメント部８からの発電指示値が入力切り換え部９３によりリミッタ９２に入力されるようにする。このようにしたため、発電指示値が燃料電池スタック２２の制限を超える値であった場合であっても、リミッタ９２で制限をかけることができるため、安全度を確保して燃料電池システム２０の運転を続けることができる。

【００２６】

【発明の効果】以上説明したように、請求項１に記載した発明によれば、水素排出手段が閉故障または開故障した場合には、電気的原因であろうと機械的原因であろうと、圧力異常が発生することに変わりはないため、原因の如何に関わらず水素排出手段の閉故障あるいは開故障を検知することができる。また、前記過渡状態判定手段において過渡状態と判定した場合には水素排出手段の故障判定は行わないため、故障判定の誤認識を排除することができる。

【００２７】また、請求項２に記載した発明によれば、水素排出手段が閉故障であった場合でも、発電時の生成水の発生量を最小限度にすることができ、燃料電池の発電能力を一定範囲で保持させることができる。

【００２８】また、請求項３に記載した発明によれば、水素排出手段が開故障であった場合でも、燃料供給手段から供給される水素が、燃料電池に供給される前に燃料排気循環路を経由して排出されることがなくなるた

め、水素の無駄な排出を防止することができる。

【図面の簡単な説明】

【図１】　図１はこの発明の実施形態における燃料電池システム２０の制御装置を示す概略構成図である。

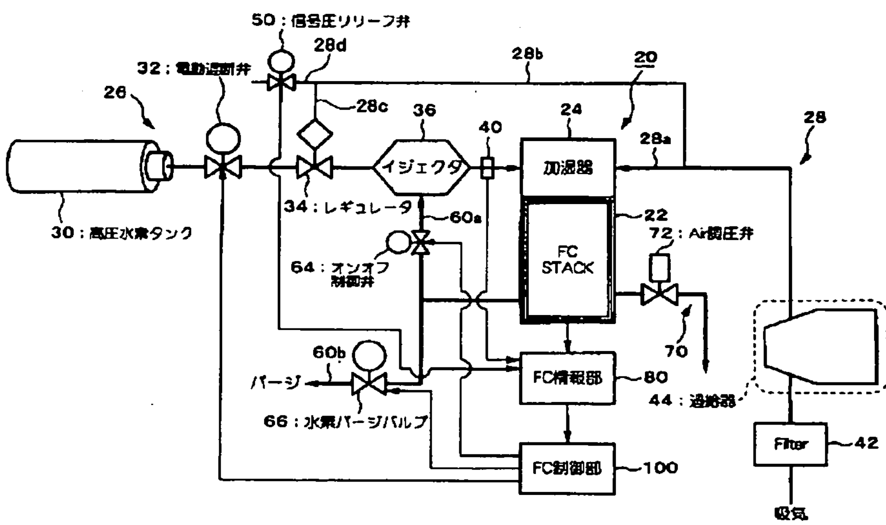
【図２】　図２はこの発明の実施形態における水素パージバルブ故障検知の処理フローである。

【図３】　この発明の実施形態における燃料電池制御装置を搭載した燃料電池自動車の要部を示す構成図である。

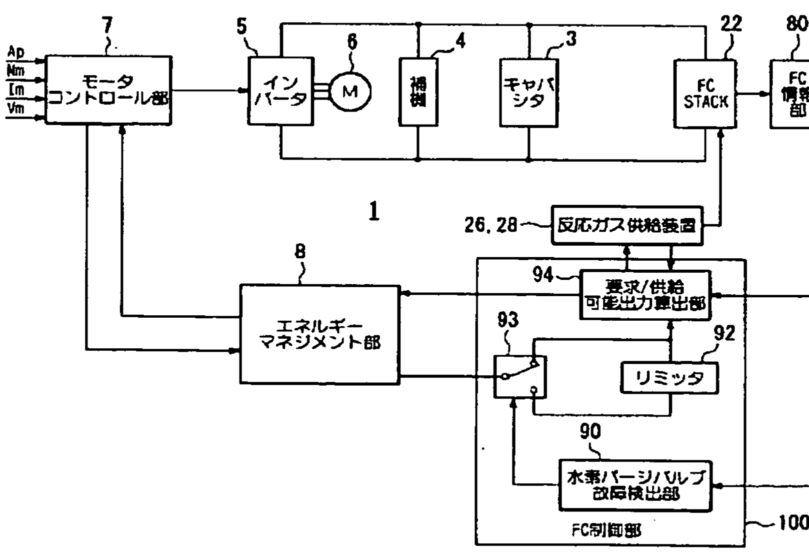
【符号の説明】

１　燃料電池自動車
７　モータコントロール部
８　エネルギーマネジメント部
２０　燃料電池システム
２２　燃料電池スタック
６０ｂ　水素循環流路
６４　オンオフ制御弁
６６　水素パージバルブ
９０　水素パージバルブ故障検出部
９２　リミッタ

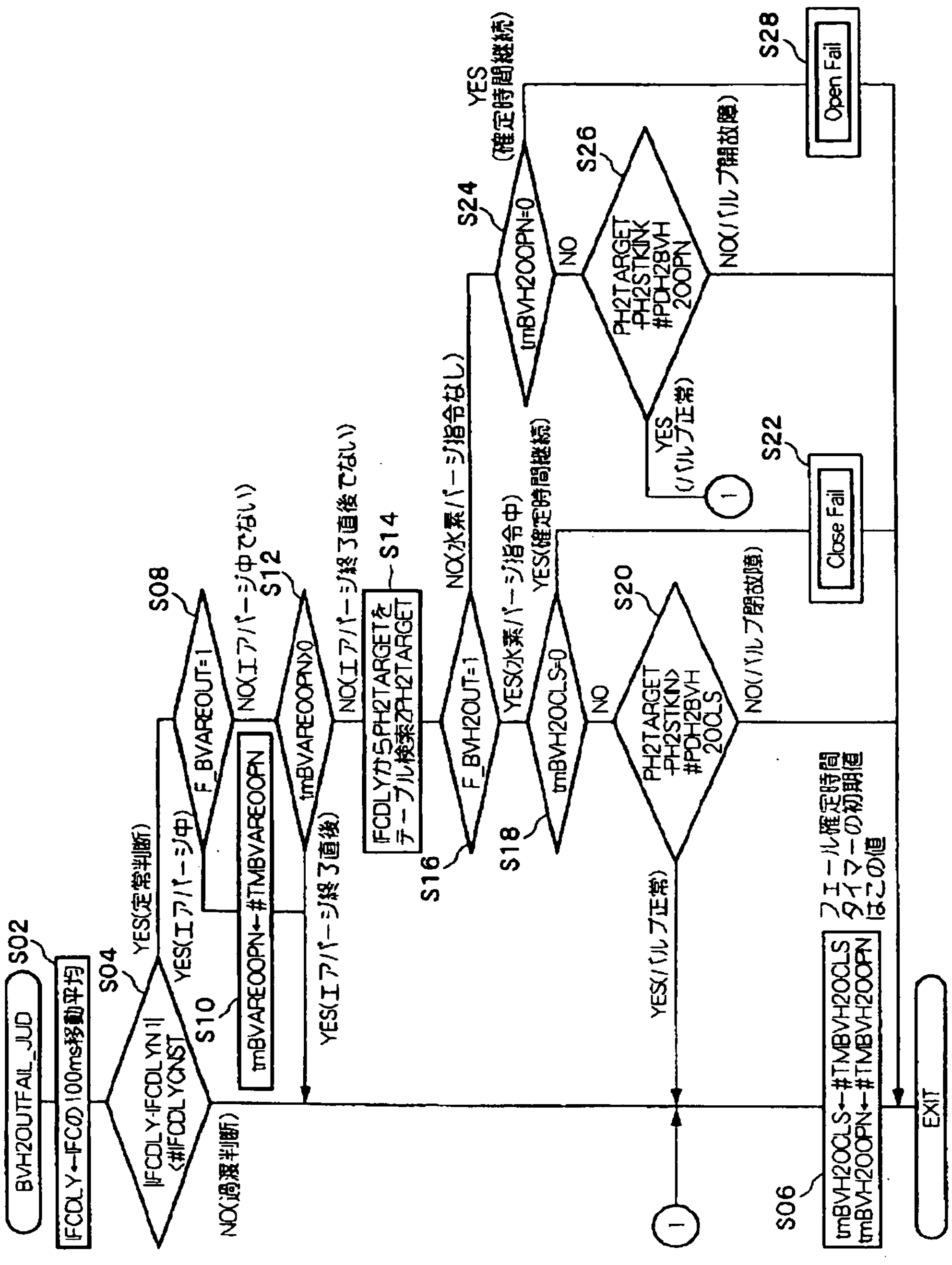
【図１】



【図３】



【図２】



フロントページの続き

(72)発明者　林　正規
埼玉県和光市中央１丁目４番１号　株式会社本田技術研究所内

(72)発明者　背柳　暁
埼玉県和光市中央１丁目４番１号　株式会社本田技術研究所内

Ｆターム(参考)　5H026 AA06
5H027 AA06 BA13 BA19 KK05 KK52
MM01 MM26